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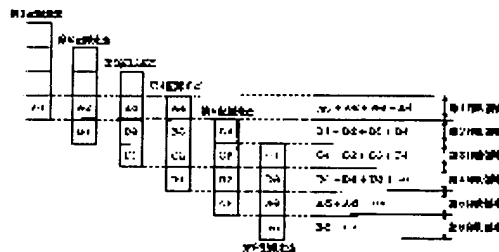
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(54) METHOD AND EQUIPMENT FOR RECORDING IMAGE

(57)Abstract:

PURPOSE: To enable formation of an image of high quality by executing printing by using a different random mask pattern for each printing area and each sort of ink, in a multipass recording system.

CONSTITUTION: In a multipass recording system wherein printing is executed by recording scannings in a plurality of times, the printing through the intermediary of a mask A-1 is executed for a first printing area in a first recording scanning, and the printing through the intermediary of masks A-1, A-2, A-3 and A-4 is executed in an overlapping manner for the first printing area in subsequent scannings, whereby the printing is completed. The mask A-1 shows a mask for which a start pointer is referred to at a prescribed position in a memory area in a main body. While the mask A-2 is referred to for the first printing area in a second recording scanning, the mask A-2 is also referred to by shifting the position of the start pointer at the time of the first recording scanning by a specific part in the memory area in the main body.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the image recording method of an ink-jet method and equipment which record by making ink breathe out from a recording head, concerning the image recording method and equipment.

[0002]

[Description of the Prior Art] Generally, picture output units, such as a printer, a copying machine, and facsimile, are constituted so that the picture which consists of a dot pattern on recorded materials, such as paper and plastics sheet metal, may be recorded based on image information. This kind of recording device can be divided into an ink-jet formula, a wire dot formula, a thermal formula, a laser beam formula, etc. by the recording method, and the ink-jet formula of them (ink-jet recording device) carries out regurgitation flight of the ink (record liquid) drop from the delivery of a recording head, and it is constituted so that this may be made to adhere to a recorded material and may be recorded.

[0003] In recent years, many picture output units come to be used and high-speed record, high resolution, high picture quality, low noise, etc. are demanded from these picture output units. The aforementioned ink-jet recording device can be mentioned as a recording device which meets such a demand. In an ink-jet recording device, in order to record by making ink breathe out from a recording head, stabilization of the ink regurgitation is required of filling the above-mentioned demand. Conventionally, stabilization of the ink regurgitation was attained with the following meanses.

[0004] The cap was prepared in the delivery of a recording head, when performing suction recovery action which attracts ink from a delivery and cancels the poor regurgitation, it was used, and capping of a delivery was performed in order to aim at dryness prevention of the ink in a delivery. Moreover, Myst generated at the time of the ink which has rebounded from the record medium near the delivery. or the regurgitation is accumulated as the regurgitation is carried out, this accumulated ink is connected with a delivery, and the poor regurgitation, such as non-regurgitation and a kink, may be caused. In order to prevent this, surface ink was wiped off by polyurethane rubber's etc. wiping the front face (face side) of a recording head, and carrying out wiping by the member. although it wipes, a member wipes and it is based on the quality of the material or mechanical setups, in order to always maintain the performance -- wiping -- a member -- it is necessary to make the front face of the very thing pure The cleaning mechanism in which the ink which wipes, presses a member against an absorber etc. as the means, and was scratched by wiping was made to absorb was established in many cases.

[0005] However, although stabilization of the ink regurgitation is attained as mentioned above by the ink-jet recording device side, the grace of the picture recorded has a large place depending on the performance of a recording head simple substance. The slight difference produced at the time of recording head manufacture processes, such as a configuration of the delivery of a recording head and variation of an electric thermal-conversion object (regurgitation heater), did influence in the discharge quantity and the direction of the regurgitation of ink which are breathed out, respectively, and, finally had become the cause of degrading picture grace as concentration nonuniformity of the formed picture.

[0006] The example of picture degradation by the slight difference in an above-mentioned recording head is explained below with reference to drawing 7 and drawing 8. In drawing 7, 1101 is the multi-head of an ink-jet recording device, and since it is easy, it shall be constituted by eight nozzles 1102. 1103 is the ink drops breathed out by the nozzle 1102.

[0007] As shown in drawing 7, it is the same discharge quantity from each nozzle 1102, and it is an ideal that each ink drops 1103 are breathed out in the same direction. If the ideal regurgitation is performed as shown in (a) of drawing 7, as shown in (b) of drawing 7, the dot to which the size was equal will reach the target on space, and the picture which does not have concentration nonuniformity on the whole will be acquired. In this case, the concentration distribution of the direction of a nozzle list of the dot which reached the target becomes almost uniform as shown in (c) of drawing 7.

[0008] However, as mentioned above, there is variation in each nozzle in fact, respectively. The example is shown in drawing 8. In drawing 8, since each sign is the same as that of drawing 7, explanation is omitted. As shown in (a) of drawing 8 in fact, since variation has arisen in the size and direction of ink drops which are breathed out from each nozzle 1102, if it prints in them like the above as it is, as shown on space at (b) of drawing 8, they will be reached. According to (b) of drawing 8, the portion of the blank paper which cannot fill area factor 100% periodically exists to head main scanning direction, and a white muscle which a dot overlaps reverse more than required and is seen in the center of (b) of drawing 8 has occurred.

that **** occurs] In this case, the concentration distribution of the direction of a nozzle list of the dot which reached the target comes to be shown in (c) of drawing 8.

[0009] As long as it usually saw by human being's eyes in the conventional ink-jet recording device the above result, the phenomenon shown in above-mentioned drawing 8 is sensed as concentration nonuniformity. A method which is explained below conventionally is devised as an above-mentioned cure against concentration nonuniformity, and the method is explained below with reference to drawing 9 and drawing 10. Drawing 9 uses the multi-head 2001 with the variation shown

in (d) of above-mentioned drawing 8 , and shows the example which performed printing by the multi-pass recording method explained below.

[0010] (a) of drawing 9 shows three scans (scan) by the multi-head 2001. In (a) of drawing 9 , since each sign is the same as that of (a) of drawing 7 , explanation is omitted. Although the scan of the multi-head 2001 is carried out 3 times in (a) of drawing 9 in order to complete a printing field like (b) of drawing 7 , and (b) of drawing 8 , as shown in (b) of drawing 9 , the printing field of the 4-pixel unit which is the half of the multi-head 2001 is completed by two scans, i.e., a two pass.

[0011] drawing 9 -- eight nozzles of the multi-head 2001 -- the upper -- four nozzles -- lower -- the dot which it is divided into two groups of four nozzles, and one group prints with 1 time of a scan thins out regular image data in an abbreviation half. And the dot of the image data of the remaining half is embedded at the time of the 2nd scan, and printing of a 4-pixel unit field is completed. The above recording methods are called a multi-pass recording method below.

[0012] Since the influence of the printing picture on variation peculiar to each nozzle will be reduced by half even if it uses a multi-head equal to a multi-head with the variation shown by (a) of drawing 8 if the multi-pass recording method mentioned above is used, the printed picture comes to be shown in (b) of drawing 9 , and **** and a white muscle which are looked at by (b) of drawing 8 stop being not much conspicuous. Therefore, the concentration distribution of the direction of a nozzle list of the dot which reached the target comes to be shown in (c) of drawing 9 , and concentration nonuniformity is considerably eased compared with (c) of drawing 8 .

[0013] Although it divides in 1 scan eye and 2 scan eye in the form where it compensates for image data mutually according to a predetermined array in case it records by the above multi-pass recording methods, it is conventionally most common as this image data array (infanticide pattern) to use the alternate pattern which becomes a hound's-tooth check exactly for 1 pixel of every direction as shown in drawing 10 .

[0014] Therefore, printing is completed by 1 scan eye to which a unit printing field (here 4-pixel unit) prints a hound's-tooth check, and 2 scan eye which prints a reverse hound's-tooth check. The example of printing by infanticide of this hound's-tooth check is explained in detail using drawing 10 . (a) of drawing 10 , (b), and (c) explain how record of the fixed field which exists when alternate and a reverse alternate pattern are used is completed using a multi-head with the eight same nozzles 1102 as drawing 7 - drawing 9 , respectively.

[0015] By 1 scan eye first shown in (a) of drawing 10 , an alternate pattern (slash round mark) is recorded using four nozzles the bottom. Next, record of a deed and a reverse alternate pattern (white round mark) is performed for an ejection to 2 scan eye shown in (b) of drawing 10 by 4 pixel (1/2 of head length). Furthermore, the ejection only for 4 pixel (1/2 of head length) is again performed to 3 scan eye shown in (c) of drawing 10 , and an alternate pattern is again recorded on it. Thus, the record section of a 4-pixel unit is completed for every scan by performing record of the ejection of a 4-pixel unit, and a 1000 birds and a reverse alternate pattern by turns one by one.

[0016] About thinning out by the above-mentioned hound's-tooth check pattern, they are JP,60-214670,A and JP,60-214671,A. And USP4622561, USP4963882, and USP4967203 It can refer to. The example of electric control in the case of performing infanticide printing by hound's-tooth check pattern which was mentioned above is explained below with reference to drawing 11 and drawing 12 . Drawing 11 shows the control composition which generates an above-mentioned hound's-tooth check and an above-mentioned reverse hound's-tooth check pattern. The Head unit section 900 sets print-data Si to the 8-bit shift register 901 according to print-data synchronous-clock CLKi. And a LATCH* signal is outputted and the print data set to the shift register 901 are latched to latch 902. Then, BEi1*, BEi2*, BEi3*, and BEi4* The transistor array 903 of the Head unit section 900 is driven by turning ON a signal, respectively, and it prints by making a heater 904 generate heat. CARESi* A signal is a reset signal which clears the latch of latch 902. It is started by the Heat Trigger signal and one heat outputs the signal of BEi1*, BEi2*, BEi3*, and BEi4* from a pulse generator 905.

[0017] In order to cull out, a Heat Trigger signal strikes a flip-flop 906, and the signal (for example, BEi1* and BEi3*) which carries out a mask to the degree of heat by turns is changed. The timing chart in the above control is shown in drawing 12 .

The signal by which a mask is carried out as shown by the timing chart of drawing 12 in fact is the output signal DATAENB of a flip-flop 906. It is controlled by High/Low. In drawing 12 , if a Heat Trigger signal starts, BEi1*, BEi2*, BEi3*, and a BEi4* signal are set to Low, and each nozzle heats. The timing by which the mask was carried out is written by the drawing destructive line, and it is DATAENB. It corresponds with the signal. An EVEN signal and ODD It is a signal for initial setting of a mask pattern, with a line to print by the alternate pattern, if an EVEN signal is sent before printing of one line, a flip-flop will be preset, and both signals are BEi1* and BEi3*. A signal is turned on previously and alternate printing of it is attained. Moreover, at a line to print by the reverse alternate pattern, it is ODD before printing of one line. If a signal is sent, a flip-flop will be reset, and they are BEi2* and BEi4*. A signal is turned on previously and reverse alternate printing of it is attained.

[0018] As explained above, the technology of losing the nonuniformity of printing concentration was conventionally known for the ink-jet recording device by the multi-pass recording method.

[0019] [Problem(s) to be Solved by the Invention] However, even when the above multi-pass records were performed, depending on duty, concentration nonuniformity was not canceled at all and check **** squirrel ***** had occurred concentration nonuniformity especially new in halftone] conventionally. this invention is made in order to solve this problem. Hereafter, the problem generated conventionally is explained in detail with reference to drawing 13 - drawing 16 .

[0020] The image data which a printer generally receives is already array-ized regularly. In a recording device side, the constant rate of these data is accumulated to a buffer, a new mask (picture array pattern) called alternate [which was mentioned above], or reverse 1000 birds is covered, and printing is performed only about the pixel from which the both sides of image data and a mask changed into ON state.

[0021] Below, with reference to drawing 13 -15, the situation of printing with 1000 birds or a reverse alternate mask is explained. In drawing 13 , the example of the pixel showing a part of already array-ized image data by which 1710 was accumulated at the buffer, the mask of the alternate pattern in which the pixel by which 1720 allows an one-pass eye printing was shown, and 1730 are the masks of the reverse alternate pattern in which the pixel which allows a two pass eye printing

was shown. 1740 and 1750 express with the one-pass eye and the two pass eye the pixel of 1710 printed with the mask of 1720 and 1730, respectively.

[0022] In drawing 13, when accumulated at the buffer as a pixel which occupies 25% of all fields as the already array-ized image data shown in 1710 in, it considers printing the pixel of this field of 1710. Usually, the pixel shown in 1710 is arranged at the state where print data vary if possible, in order to keep concentration uniform in the specified fixed field. In the image processing before transmitting to the main part of a printer, it depends on what area gradation was performed what array the pixel of 1710 would be.

[0023] Although the pixel shown in 1710 is an example of a certain picture array in case a pixel occupies 25% of field, if it prints by covering the mask of 1720 and 1730, respectively to such image data, as shown in 1740 and 1750, where data are divided equally exactly, it will be distributed and recorded on an one-pass eye and a two pass eye. Next, in drawing 14, when accumulated at the buffer as a pixel which occupies 50% of all fields as the already array-ized image data shown in 1810 in, it considers printing the pixel of this field of 1810. Since it is the same as that of 1720, 1730, 1740, and 1750 of drawing 13 respectively, explanation is omitted about 1820, 1830, 1840, and 1850 of drawing 14.

[0024] In the case where image data to which a pixel as shown in 1810 of drawing 14 occupies 50% of all fields is printed, when the pixel shown in 1810 is arranged by the state where it varied most, a bird clapper can be easily imagined in the array state which was completely in agreement with either the alternate pattern mask 1820 or the reverse alternate pattern mask 1830. In drawing 14, if the pixel of 1810 is in agreement with the mask of 1820 or 1830, as only an one-pass eye shows to 1840, printing of all pixels will be completed, and as shown in 1850, by the two pass eye, it will not record at all. That is, all the pixels 1810 will be printed with the same nozzle.

[0025] As explained above, conventionally, in the example of the pixel shown in 1810 of drawing 14, the influence of the variation in a nozzle will be reflected in concentration nonuniformity as it is, and the purpose of original of the division record by the multi-pass recording method of the conventional example is no longer attained. Furthermore, in drawing 15, as the already array-ized image data is shown in 1910, when being accumulated as a pixel exceeding 50% of all fields at the buffer, it considers printing the pixel of this field of 1910. Since it is the same as that of 1720, 1730, 1740, and 1750 of drawing 13 respectively, explanation is omitted about 1920, 1930, 1940, and 1950 of drawing 15. Moreover, the pixel shown in 1910 occupies 63% of all fields.

[0026] Namely, also in drawing 15, although a printing state when the image data 1910 in the state where duty was further raised from drawing 13 and drawing 14 is inputted is shown, as shown in 1940 and 1950, as for drawing 15, it turns out that the remarkable difference has appeared in the number of printings by the one-pass eye and the two pass eye. As explained above, the concentration nonuniformity improved by the conventional multi-pass recording method in about 100% of image data of high duty also had the evil in which concentration nonuniformity will appear again, by the image data of low duty below near 50%, when the nozzle used after all inclined.

[0027] Moreover, as shown in drawing 10 mentioned above, the multi-head is always printing one of the patterns of alternate or reverse 1000 birds using all nozzles. Therefore, among showing-in drawing 10 printing fields, although a reverse alternate pattern next reaches the target after 4 pixels of alternate patterns of an upper half reach the target previously, after a reverse alternate pattern reaches the target first, next about 4 pixels of a lower half, an alternate pattern reaches the target.

[0028] Therefore, after many dots reach the target by the one-pass eye in printing in the state where deviation is in a use nozzle and duty like drawing 15 mentioned above was raised, the printing field which a little dot reaches by the two pass eye, and the printing field which is hardly reached by the one-pass eye, but a lot of dots reach by the two pass eye will appear one half of alternately [of a multi-head] with width of face every.

[0029] According to the above phenomena, there was evil which is especially explained to the bond section of an ink-jet recording method below. In an ink-jet recording method, when another dot is put on the dot recorded previously, the direction of the dot struck after the dot previously recorded in the lap portion is in the inclination which sinks in the record space depth direction. The 1st ink drop is breathed out by (a) of drawing 16, it is (b) of drawing 16, the 1st ink drop dyes, next, the 2nd ink drop is breathed out by (c) of drawing 16, it is (d) of drawing 16, and it is the cross section of record space having shown it typically, and the 2nd ink drop dyes [drawing 16 is deeper than dyeing of the 1st ink drop, and] it.

[0030] In drawing 16, although coloring matter, such as a color in the breathed-out ink, is combined with a record medium physically and chemically, combination of a record medium and coloring matter is limited at this time. Therefore, since priority is given to combination with a record medium, the 1st ink coloring matter previously breathed out by the kind of coloring matter in the limitation which does not have a big difference in bonding strength remains to a record intermediation body surface mostly, and in a record intermediation body surface, it is hard to combine the 2nd ink coloring matter breathed out later, therefore it is thought that it sinks in the space depth direction and dyes.

[0031] Furthermore, when the behavior of the ink in the fiber level inside a record medium is considered, compared with the state where the fiber combined with the color in ink etc. at once is not combined at all, the hydrophilic property is strong. Therefore, the ink drop which adjoined the strong hydrophilic portion and reached the target can tend to draw near in the direction which the front ink drop has reached. Moreover, a hydrophilic property is so strong that the previous ink drop is not fully established (i.e., so that many moisture is included), and it can be easy to draw the ink drop which reached contiguity near.

[0032] Therefore, the printing field which a lot of dots reach by the one-pass eye, and a little dot reaches by the two pass eye like aforementioned drawing 15, In the case where the printing field where a lot of dots reach a two pass eye appears one half of alternately [of a multi-head] with width of face every, without hardly being printed by the one-pass eye On the boundary, the force which can be drawn near works strongly to the dot which reaches later the field contiguous to the printing field which a lot of ink has reached. Moreover, to the dot which reaches later the field contiguous to the printing field which conversely little ink has reached, the force which can be drawn near works weakly.

[0033] Therefore, on the boundary of printing fields, the place where concentration is deep, and a thin place will exist, and it will become concentration nonuniformity. Such concentration nonuniformity especially tends to be conspicuous by halftone, and has the periodicity which appears one half of alternately [of a multi-head] with width of face every. Moreover, when printing by thinning out using a certain specific mask pattern, print data and a mask pattern may have the same period. In this case, the amplitude of concentration and the amplitude of print data to which it comes from arrangement of the printing pixel by the mask pattern and a non-printed pixel overlap, and it will resonate and will have a pattern that there is specific directivity with the dot array of the formed picture. Generally, this phenomenon is called moire. This tends to be conspicuous when there is a picture of two or more lines which used the same mask pattern, and it is tended to recognize it a user. This moire has a large place depending on the periodicity of a mask pattern.

[0034] According to evil which was explained above, as for printing by the multi-pass recording method from the former which was carrying out variation in a nozzle etc. to the amendment sake, only inadequate quality of image was still obtained about concentration nonuniformity. The evil of such concentration nonuniformity has the periodicity which appears by turns in the printing field of a certain width of face, and is fully easy to be recognized with human being's visual sense at a sake as concentration nonuniformity. Therefore, abolishing the periodicity of concentration nonuniformity is one means by which an operator is not made to recognize such evil as degradation of picture grace.

[0035] Moreover, also in other image recording methods, there is same problem too, for example with the image recording equipment of the type using two or more record elements. For example, by the nonuniformity of thermolysis, or the nonuniformity of the heater element itself, the same problem may also generate a hot printing method.

[0036]

[Means for Solving the Problem] this invention was made for the purpose of solving the technical problem mentioned above, and is equipped with the following composition as a way stage which solves the technical problem mentioned above. Namely, a pattern reference means to refer to two or more random mask patterns. Two or more random mask patterns which have the printing means which carries out printing of 1 or more dots for a certain printing field to one printing point by two or more scans, and are referred to by the aforementioned pattern reference means. It is a pattern different, respectively and is characterized by printing the aforementioned printing means according to two or more random mask patterns referred to by the aforementioned reference means for every scan. For example, the random mask pattern memorized by the aforementioned pattern storage means is characterized by arranging dot arrangement of each color in a color-reproduction mask at random in three dimensions.

[0037] Furthermore, it has a printing means for a pattern generation means to generate a random mask pattern, a pattern reference means to refer to two or more random mask patterns, and a certain printing field, by two or more scans, and the non-printed pixel and the printing pixel are arranged in random number, and the random mask pattern generated by the aforementioned pattern generation means prints the aforementioned printing means according to two or more random mask patterns generated by the aforementioned pattern generation means for two or more ink kinds of every.

[0038] For example, it is characterized by for the aforementioned printing means breathing out ink and recording a picture, for example, is characterized by for the aforementioned printing means breathing out ink using heat energy, and recording a picture.

[0039]

[Function] In the multi-pass recording method which prints by the writing scan of multiple times to a printing field in the above composition. When a non-printed pixel and a printing pixel print to each printing field and each ink kind using a random mask pattern different, respectively arranged in random number. Without giving a pattern period to an infanticide array, also in the picture formed, the periodicity of the concentration nonuniformity generated conventionally is abolished and high-definition image formation becomes possible.

[0040] Furthermore, there is the characteristic operation effect of becoming possible to raise the tone reproduction of a multiple value further, by equalizing the picture concentration formed by random-number-izing a 3-dimensional color-reproduction mask on a macro target, and applying a multi-pass recording method also about multiple-value record of a multi-drop.

[0041]

[Example] Hereafter, the example concerning the image recording method of this invention and equipment is explained in detail with reference to a drawing.

<1st example> drawing 1 is the block diagram of the image recording equipment of this example. In drawing 1, 10 shows the main part of image recording equipment (printer) of this example, and the image data sent with the command from the host computer 1 is stored in the receive buffer 3 of image recording equipment 10 through an interface 2. The receive buffer 3 has the capacity of several k - 10 K bytes of number. Next, in the command analysis section 4, command analysis to the command sent with the image data stored in the receive buffer 3 is performed, and image data is sent to the text buffer 5. In the text buffer 5, image data is held as an intermediate form for one line, and processing to which the address of the printing position of each character, the kind of ornamentation, a size, a character (code), and a font etc. is added according to a command analysis result is performed. The capacity of the text buffer 5 differs by every model, and if they is a serial printer and they is the capacity for several lines, and a page printer, they has the capacity for 1 page. Furthermore, it develops in the expansion section 6, and the image data stored in the text buffer 5 is stored after having been made binary by the print buffer 7. And the developed binary-ized image data is sent to a recording head 8, and printing is performed.

[0042] In this example, after performing infanticide processing by the random mask pattern to the binary-ized image data currently stored in the print buffer 7, it has sent to the recording head 8. Therefore, it is also possible to set up a random mask pattern according to the state of the print data currently stored in the print buffer 7. In addition, there are some which develop in the expansion section 6 immediately after the command analysis by the command analysis section 4, and write the record

data accumulated to the receive buffer 3 in the print buffer 7, without having the text buffer 5 depending on the kind of image recording equipment.

[0043] this example image recording equipment of a more than is explained to a detail below. Multi-pass printing of four paths is performed in this example, a random mask pattern is set up for every printing field, and the printout is carried out using a further different random mask pattern for every path and every color. The example of the memory composition which generates the random mask pattern used for drawing 2 by this example is shown.

[0044] Since a random mask pattern is required by four paths in this example, although memory with a size of 32 K bytes (the direction of a raster : the direction of a 4 byte x column : 8 K bytes) is used as shown in drawing 2 , the random mask pattern is generated, and the memory shown in drawing 2 is divided into Fields A, B, C, and D in this example, respectively, the four fields are continuing. And the mask shown with eight start pointers of 1-8 for every field is stored.

[0045] The memory storage shown in drawing 2 is recorded on RAM of this example equipment, can set up the position (start pointer) to read freely, can shift a start pointer for every printing field further, and refer to the memory for it. In addition, the random mask pattern stored in the memory storage shown in drawing 2 shall be beforehand created using a random number.

[0046] Hereafter, the example of use of the random mask pattern in this example is explained with reference to drawing 3 and drawing 4 . The example of the recording head to each printing field and its scan is shown in drawing 3 , and the example of the random mask pattern used for drawing 4 by each scan is shown. In drawing 3 , by the 1st writing scan, printing through the mask A-1 is performed to the 1st printing field, in subsequent scans, printing through a mask A-1, A-2, A-3, and A-4 is performed in piles, and printing completes the 1st printing field. In addition, the mask A-1 expresses the mask with which a start pointer is referred to in the position of 1 in the field of A in drawing 2 , and a mask B-1, C-1, and D-1 grade are also the masks with which the position of a start pointer is similarly referred to by 1 in each field.

[0047] Moreover, in drawing 3 , the mask A-2 is referred to to the 1st printing field by the 2nd writing scan. In the field of A of drawing 2 , at the time of the 1st writing scan, a mask A-2 shifts the start pointer which was the position of 1 in the position of 2, and is referred to. It is referred to by shifting the position of a start pointer to the mask referred to by the preceding-record scan, respectively similarly about a mask B-2, C-2, and D-2.

[0048] Although the amount which shifts an above-mentioned start pointer can be set up arbitrarily, it has shifting composition at a time 256 columns in one field in this example. Therefore, it becomes the 9th writing scan that a start pointer comes to the same position. Therefore, in a near printing field, it is visible as if it was using a different random mask pattern.

[0049] As explained above, by shifting a start pointer to the random mask pattern memorized on RAM, the random mask pattern from which plurality differs can be referred to, and printing by the multi-pass recording method with little concentration nonuniformity is attained from one memory storage. As explained above, composition which refers to a different random mask pattern for every writing scan in printing by the multi-pass recording method according to this example is realized, and it becomes possible to suppress alignment with print data and a random mask pattern as much as possible. Therefore, it becomes possible to mitigate the concentration nonuniformity of the output picture by the variation in a nozzle etc.

[0050] Although explanation beyond <the 2nd example> was given in consideration of the case of monochrome printing, this invention is not limited to the above example and, also in color printing, can be applied. Next, the case where this invention is applied to color printing is explained. In addition to the method of changing a random mask pattern for every writing scan of the 1st example mentioned above, by changing a random mask pattern between each color further, in the 2nd example, it considers in the overprint between each color so that alignment of the image data and random mask pattern which are the defect of the random number by the pseudo-random number may be lost.

[0051] The creation method of the random mask pattern at the time of color printing in the 2nd example is explained with reference to drawing 5 . Drawing 5 is a block diagram showing the situation of the random mask pattern creation at the time of color printing in the 2nd example. In the 2nd example, it is explained that the case of multi-pass printing of four paths mentioned above.

[0052] In drawing 5 , the picture field of a specific size is set up first and the inside of it is filled with four parameters (a, b, c, d) of the same number. And out of the parameter, two are chosen in random number and it changes mutually. By performing this processing two or more times, each parameter creates the mask pattern arranged at random. Although the number of times which changes is arbitrary if it is only the number of times which can give random nature to a mask, it is performed 25000x15 times in the 2nd example.

[0053] The state of the parameter of the random array created as mentioned above is memorized to ROM. And each infanticide mask is created. For example, four parameters a, b, c, and d stand a bit only to a position with each parameter, and create each mask pattern noting that they correspond to four masks A, B, C, and D, respectively.

[0054] Since the position of each parameter is arranged at random, the created mask also serves as a random mask pattern which has a random array. Furthermore, the random mask pattern by which creation was carried out [aforementioned] is one picture field in the beginning, and since it is created from there, it turns into a random mask pattern which can surely interpolate the picture of a basis 100%. In addition, above-mentioned random mask pattern creation processing is performed by CPU, and the created random mask pattern is memorized and used for RAM. CPU in the case of random mask pattern creation and the relation of ROM and RAM are shown in drawing 6 .

[0055] For example, in carrying out random mask pattern creation by the main part of a printer, the data of a random array are beforehand stored in ROM etc., and the above-mentioned random mask pattern is created to timing, such as a power supply ON, and where a random mask pattern is completed, it memorizes to RAM etc. And in case a random mask pattern is actually referred to, a random mask pattern is read from RAM at the time of the lamp rise of the carriage of each writing scan, and it prints by taking AND with the print data stored in the print buffer.

[0056] Therefore, it becomes possible to change a random mask pattern according to the print mode in the timing which

creates a random mask pattern. For example, creation of the random mask pattern for the object for two pass printing, the object for 4 path printing, and 8 path printing is also attained from the same random mask pattern. Although determined with the number of parameters used when creating a random mask pattern, if this has 24 kinds (for example, parameters 0-23) of parameters, the path for the divisor can be made to correspond, namely, correspondence of it is attained at 2, 3, 4, 6, 8, 12, and 24 paths. Moreover, by making two or more parameters and one mask pattern correspond rather than making one parameter and one mask pattern correspond, 100% or more of interpolation, i.e., a certain specification, can come out comparatively, and double printing can be performed, and it is the number of the parameters which also set up the rate, and it becomes possible to set up arbitrarily.

[0057] In addition, generally, in the binary printer, the dot has shifted for every color with the color-reproduction mask, i.e., a color-reproduction mask is small, and since it is rare when the output picture consists of dot-on dots, even if it applies the same mask pattern for every color, there are many satisfactory examples. However, a part of output picture may consist of dot-on dots at least, and, in such a case, especially the 2nd example is effective.

[0058] Moreover, the 2nd example is effective like the above-mentioned case, when outputting a shade picture only between colors. Furthermore, also in the image recording equipment of the multi-dot method which takes the composition of a dot-on dot mostly, this example is applicable. In color printing, the pointer position of the random mask which is the distance itself from which the position of a recording head has shifted when a recording head is lining up side-by-side, and is used may be shifted, it may give gap of the fixed value of at least 1 or more dots between colors, and may make the amount of gap itself random-number-ize.

[0059] As explained above, according to the 2nd example, the concentration nonuniformity of an output picture is mitigated like the effect of the 1st example mentioned above by referring to a random mask pattern which is different for every color also in color printing.

The 3rd example concerning the <3rd example> this invention is explained below.

[0060] The 3rd example explains the multiple-value record by the multi-drop which applied the multi-pass recording method. Generally, although it is an overprint by the dot-on dot of about four values in a multi-drop and the color reproduction of 256 gradation is performed using about 2x2 color-reproduction mask, in order to lose the concentration nonuniformity of the output picture by the variation in a recording head, application of the multi-pass recording method which shifts the nozzle too recorded also in a multi-drop for every path can be considered.

[0061] Generally, with the image recording equipment of the multi-drop which applied the multi-pass recording method, since it is multiple-value record, it is constituted focusing on printing on the special paper represented by coat paper with little color mixture with sufficient color-reproduction nature, and the property of osmosis on the recording paper of adjoining dots mentioned above is not taken into consideration. However, if there is naturally the need of taking color-reproduction nature into consideration also in a multi-drop and the homogeneity of color-reproduction nature is taken into consideration in a multi-drop, you have to pay your attention to combination, such as placing sequence of each color. For example, when reproducing the same green, hues may differ a little by the case where it draws in order of Y, Y, Y, and C, and the case where it draws in order of C, Y, Y, and Y.

[0062] This is for the property that it will be hidden under the ink of the dot which the ink of the dot printed later printed previously, when a dot is printed further in piles on the dot printed previously, as mentioned above. Although it depends for this property on the property of a record medium, generally this property is strong in many cases. Therefore, in the 3rd example, placing sequence of this color is random-number-ized, and output picture concentration is equalized on a macro target. That is, in the-like 3-dimensional color-reproduction mask which is the presentation space of a multiple value, the placing sequence of a color is randomized and printing is performed.

[0063] Moreover, in both-way printing using the recording head lining up side-by-side etc., since the placing sequence of a color becomes reverse in an outward trip and a return trip, it is changing at random the combination of the scan printed on an outward trip, and the scan printed in a return trip and it becomes possible to replace the placing sequence of a color to equalize output picture concentration on a macro target. Moreover, it becomes possible by changing the combination of two or more sorts of ink at random like [the same is said of the case of a shade printing recording method, and / in case two or more kinds draw combining dark ink and light ink] the above to equalize output picture concentration on a macro target.

[0064] As explained above, according to the 3rd example, also in a multi-drop, it becomes possible to equalize the color-reproduction nature of an output picture on a macro target.

The <4th example> The 4th example describes the case where the multi-pass method which added infanticide processing further is combined, to the multi-drop of the 3rd example mentioned above.

[0065] Hereafter, the case where it prints by the multi-pass method of 4 or more ****s is explained, performing infanticide processing on the color-reproduction mask of 2x2 in the overprint of the dot-on dot of four values in the 4th example. In the 4th example, printing is performed like the 2nd example mentioned above with reference to the random mask pattern interpolated so that the sum total of two or more parameters at the time of creating the random mask pattern in color printing might become 100%.

[0066] Generally, if four colors are superimposed without infanticide processing in a multi-drop, although it is possible to print on high record frequency relatively to the movement of carriage by printing of four paths or an one pass, in the 4th example, it is the number of paths beyond it, and prints by adding infanticide processing further. While the blot between contiguity dots is improved by increasing the number of paths, performing infanticide processing, and drawing the predetermined number of dots, the tone reproduction of the portion superimposed on the dot is also improved remarkably.

[0067] Although there was generally a problem that the saturation of a tone reproduction was early, in multiple-value printing by superposition of a dot Since a next dot will be printed as the cause before the ink of a dot struck previously is established if a dot is driven in succeeding the time of performing multiple-value record as mentioned above While the color of ink will sink

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CLAIMS

[Claim(s)]

[Claim 1] It is the image-recording method of carrying out printing according to two or more random mask patterns by which two or more random mask patterns which have the pattern reference process of referring to two or more random mask patterns, and the presswork which carries out printing of 1 or more dots for a predetermined printing field to one printing point by two or more scans, and are referred to according to the aforementioned pattern reference process are patterns different, respectively, and the aforementioned presswork was referred to according to the aforementioned reference process for every scan as the feature.

[Claim 2] The random mask pattern memorized according to the aforementioned pattern storage process is the image recording method according to claim 1 characterized by arranging dot arrangement of each color in a color-reproduction mask at random in three dimensions.

[Claim 3] The pattern generation process which generates a random mask pattern, and the pattern reference process of referring to two or more aforementioned random mask patterns, Have the presswork which prints a predetermined printing field by two or more scans, and the random mask pattern generated by the aforementioned pattern generation process is arranged in [a non-printed pixel and a printing pixel] random number. The aforementioned presswork is the image recording method characterized by printing according to two or more random mask patterns generated by the aforementioned pattern generation process for two or more ink kinds of every.

[Claim 4] The aforementioned pattern generation process is the image recording method according to claim 3 characterized by reading from the pattern memorized by memory and generating a random mask pattern.

[Claim 5] The aforementioned pattern generation process is the image recording method according to claim 4 characterized by making the read-out position of the aforementioned memory adjustable.

[Claim 6] It is image-recording equipment carry out printing according to two or more random mask patterns which are patterns different, respectively in two or more random mask patterns which have a pattern reference means refer to two or more random mask patterns, and the printing means which carries out printing of 1 or more dots for a certain printing field to one printing point by two or more scans, and are referred to by the aforementioned pattern reference means, and by which the aforementioned printing means was referred to by the aforementioned reference means for every scan as the feature.

[Claim 7] The random mask pattern memorized by the aforementioned pattern storage means is image recording equipment according to claim 6 characterized by arranging dot arrangement of each color in a color-reproduction mask at random in three dimensions.

[Claim 8] It is image recording equipment which is equipped with the following, and the random mask pattern generated by the aforementioned pattern generation means is arranged in [a non-printed pixel and a printing pixel] random number, and is characterized by printing the aforementioned printing means according to two or more random mask patterns generated by the aforementioned pattern generation means for two or more ink kinds of every. A pattern generation means to generate a random mask pattern. A pattern reference means to refer to two or more random mask patterns. It is a printing means by two or more scans about a certain printing field.

[Claim 9] The aforementioned printing means is image recording equipment according to claim 6 to 8 characterized by breathing out ink and recording a picture.

[Claim 10] The aforementioned printing means is image recording equipment according to claim 9 characterized by breathing out ink using heat energy and recording a picture.

[Translation done.]

in the depth direction of the recording paper, it is for the phenomenon in which spread also in a longitudinal direction and the linearity of concentration gradation nature falls to occur.

[0068] The picture which was further excellent in the tone reproduction can be outputted by performing infanticide processing with reference to two or more random mask patterns which can perform 100% of interpolation shown in the 2nd example mentioned above in multiple-value record of the multi-drop which was shown in the 3rd example mentioned above according to the 4th example, as explained above, and increasing and printing the number of paths. In addition, although the random number pattern using the random number as an infanticide mask used in each example was mainly explained, of course, this invention can also apply a fixed pattern. However, since moire may occur as mentioned above if infanticide etc. is performed using a fixed pattern, it is desirable to thin out the random number pattern created using the random number, and to use it as a mask.

[0069] Moreover, in the above-mentioned 1st - the 4th example, although the ink jet printer was mainly explained, even if it is the copying machine of other methods, such as a laser beam printer, and a heat transfer printer, a bubble-jet printer, it is applicable [this invention / this invention is not limited to this, and] similarly. Although especially this invention explained the print equipment of the method which it has [method] means (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used in order to make the ink regurgitation perform, and makes the change of state of ink occur with the aforementioned heat energy also in an ink-jet recording method, according to this method, it can attain the densification of record, and highly minute-ization.

[0070] About the typical composition and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called on-demand type and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the on-demand type case By impressing at least one driving signal which gives the rapid temperature rise which corresponds to recording information and exceeds film boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the foam in the liquid (ink) corresponding to this driving signal can be formed by 1 to 1 as a result, it is effective. A liquid (ink) is made to breathe out through opening for regurgitation by growth of this foam, and contraction, and at least one drop is formed. If the shape of a pulse form is carried out, since growth contraction of a foam will be appropriately performed instantly in this driving signal, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable.

[0071] As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed. The composition using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the composition arranged to a delivery which is indicated by each above-mentioned specification as composition of a recording head, the liquid route, and the field to which the heat operating surface other than the combination composition (a straight-line-like liquid flow channel or right-angled liquid flow channel) of an electric thermal-conversion object is crooked is also included in this invention. In addition, it is good also as composition based on JP,59-138461,A which indicates the composition whose opening which absorbs the pressure wave of JP,59-123670,A which indicates the composition which makes a common slot the regurgitation section of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to the regurgitation section.

[0072] Furthermore, any of the composition which fills the length with the combination of two or more recording heads which are indicated by the specification mentioned above as a recording head of the full line type which has the length corresponding to the width of face of the maximum record medium which can record a recording device, and the composition as one recording head formed in one are sufficient. In addition, you may use the recording head of the exchangeable chip type with which the electric connection with the main part of equipment and supply of the ink from the main part of equipment are attained, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one by the main part of equipment being equipped.

[0073] Moreover, it is a book to add the recovery means against a recording head established as composition of the recording device of this invention, preliminary auxiliary means, etc. It is effective in order to perform record stabilized by performing reserve regurgitation mode in which the preheating means by the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head and the regurgitation different from record are performed, if these are mentioned concretely.

[0074] Furthermore, by constituting not only the recording mode of only mainstream colors, such as black, but a recording head in one as a recording mode of a recording device, even with two or more combination, although it is good, it can also consider as equipment equipped with full color at least one by the double color color of a different color, or color mixture. In this invention example explained above, although ink is explained as a liquid Even if it is ink solidified less than [a room temperature or it], you may use what is softened or liquefied at a room temperature. Or by the ink-jet method, since what carries out a temperature control is common as a temperature control is performed by within the limits below 70 degreeC more than 30 degreeC for ink itself and it is in the stable regurgitation range about the viscosity of ink, ink should just make the shape of liquid at the time of use record signal grant.

[0075] In addition, in order to prevent positively by making the temperature up by heat energy use it positively as energy of the change of state from a solid state to the liquid state of ink, or in order to prevent evaporation of ink, you may use the ink which solidifies in the state of neglect and is liquefied by heating. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied when using the ink of the property liquefied for the first time by grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when

reaching a record medium. In such a case, ink is good for a porosity sheet crevice or a breakthrough which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the state where it was held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0076] Furthermore, in addition, as a gestalt of the recording device concerning this invention, although prepared in one or another object as the picture outgoing end of information management systems, such as a computer, you may take the gestalt of the reproducing unit combined with others, the reader, etc., and the facsimile apparatus which has a transceiver function further. In addition, even if it applies this invention to the system which consists of two or more devices, you may apply it to the equipment which consists of one device. Moreover, this invention cannot be overemphasized by that it can apply when attained by supplying a program to a system or equipment.

[0077]

[Effect of the Invention] In the multi-pass recording method which prints by the writing scan of multiple times to a printing field according to this invention as explained above When a non-printed pixel and a printing pixel print to each printing field and each ink kind using a random mask pattern different, respectively arranged in random number Without giving a pattern period to an infanticide array, also in the picture formed, the periodicity of the concentration nonuniformity generated conventionally is abolished and high-definition image formation becomes possible.

[0078] Furthermore, there is the characteristic operation effect of becoming possible to raise the tone reproduction of a multiple value further, by equalizing the picture concentration formed by random-number-izing placing sequence of the color of a 3-dimensional color-reproduction mask on a macro target, and applying a multi-pass recording method also about multiple-value record of a multi-drop.

[Translation done.]

